strata have been denuded from above the silurian rocks. In the Blue Mountains, too, so far as I could gather, no evidence of tertiary deposits are anywhere apparent. Here is another proof of immense antiquity. It gives us time wherein to do our work, but, furthermore, it presupposes the existence of a force whereby the work would be carried on. If the district remained dry ground during the tertiary age it could only have done so as one or more of a group of islands. Under such circumstances the rainfall must have been vastly greater than at present. Torrents might have roared down these now dry hill slopes and even rivers have flowed along these now arid valleys.

As to time for working out such grand results by such trifling agencies, of geologic time we know comparatively nothing. We have long since abandoned the old interpretation of Genesis, limiting the world's age to 6,000 years. Having done so, I am at a loss to know what reasonable argument can be adduced for refusing the geologist any extension of time whatever, short of an eternity, during which the grand results he contemplates may have been brought about.

Art. II.—*On the Theory of the Formation of Gold Nuggets in Drift.* By Mr. C. Wilkinson.

(Read 11th September, 1866.)

Mr. President and Gentlemen of the Royal Society,—It has hitherto been a moot question, and one which has elicited no small degree of discussion, respecting the occurrence of *larger nuggets* of gold in the drifts than have yet been discovered in any quartz reef; and that alluvial gold is generally of a higher standard than that obtained from the reefs.

Many theories have been introduced to account for these phenomena: among them is one which does not appear to have received that amount of attention it evidently merits. I allude to that advanced by Mr. Selwyn, the Government geologist, suggesting the probability of gold existing in solution in the mineral water permeating the silurian rocks and the gold drifts; and that this water, in its passage through the drifts, became by some unknown means decom-

posed, influencing the precipitation of the gold, which concreted, so to speak, around the most congenial nuclei presented to it, such as the particles or pieces of reef gold existing in the drifts or any other metallic substances for which it had an affinity.

Mr. Daintree, formerly of our Geological Survey, had on one occasion prepared for photographic uses a solution of chloride of gold, leaving in it a small piece of metallic gold undissolved. Accidently some extraneouus substance, supposed to be a piece of cork, had fallen into the solution, decomposing it, and causing the gold to precipitate, which deposited in the metallic state, as in the electro-plating process, around the small piece of undissolved gold, increasing it in size to two or three times its original dimensions.

Considering this accidental experiment of Mr. Daintree as in some measure bearing out Mr. Selwyn's hypothesis, I was induced to make a few simple experiments, the results of which I have now the pleasure of laying before you.

Using the most convenient salt of gold, the terchloride, and employing wood as the decomposing agent, in order to imitate as closely as possible the organic matter supposed to decompose the solution circulating through the drifts, I first immersed a piece of cubic iron pyrites taken from the coal formation at Cape Otway, far distant from any of our gold rocks, and therefore less likely to contain gold than other pyrites. This specimen (No. 1) was kept in a dilute solution for about three weeks, and is completely covered with a bright film of metallic gold. I afterwards filed off the gold from one side of a cube crystal to show the pyrites itself and the thickness of the surrounding coating, which you will observe is thicker than ordinary note paper. If the conditions continued favourable for a very lengthened period, this specimen would doubtless have formed the nucleus of a large nugget. Crystals of gold have been found to contain nuclei of brown iron ore and undecomposed iron pyrites.

No. 2 specimen contains iron pyrites, and was immersed in a solution of about 4 grs. of the chloride of gold to one ounce of water; in a short time, however, it was found that in such a strong solution the pyrites began to decompose; but after diluting to about 2 grs. to an ounce of water this decomposition apparently ceased, and metallic gold deposited wherever a particle of the sulphide existed, alike in crevices

as on the surface of the quartz, and also in a remarkable mammillary form. This was in the solution for a week.

No. 3 contains iron pyrites and galena, on both of which the gold has deposited, so that you cannot now distinguish one sulphide from the other. It remained in a solution of one gr. of chloride to the ounce of water for eight days.

Nos. 4 and 5 are similar specimens to the last mentioned, the same strength of solution being used; but they were only dipped half way into it, so that the immersed part coated with gold may be compared with the other half on which the pyrites remains unaltered.

I may here remark that a weak solution produces more perfect results than a strong one; with the latter the sulphides are partly decomposed, and the gold is covered with a dark brown powdery film, as you will observe in some of the above specimens. This film does not prevent the growth of the gold in the solution, and it may easily be rubbed off.

Nos. 6 to 13.—Iron, copper, and arsenical pyrites, antimony, galena, molybdenite, zinc-blend, and wolfram were treated in the above manner with similar results.

Brown iron ore and quartz covered with peroxide of iron were also tried in the same way, but the gold was deposited only as a fine metallic powder.

In the above experiments a small chip of wood was employed as the decomposing agent. In one instance I used a bit of leather. All through the wood and leather gold was disseminated in fine particles, and when cut through the characteristic metallic lustre is brightly reflected.

The first six of these sulphides were also operated upon simply in the solution without organic matter, but they remained unaltered.

Iron pyrites was tried with metallic copper, zinc and iron as decomposing agents; but metallic gold was deposited only as a fine powder, which settled at the bottom of the vessel.

From these experiments it would appear that organic matter is the necessary chemical agent to decompose a solution of the chloride of gold in order to precipitate the gold as a coherent coating around a nucleus presented to it; and that so far as we have yet tried, iron, copper, and arsenical pyrites, galena, antimony, molybdenite, blend, wolfram, and metallic gold, constitute especially favourable nuclei to demonstrate this chemical reaction.

Organic substances, such as fragments of wood, roots of trees, &c., exist abundantly in the gold drifts. It remains therefore a point of great importance to decide whether gold is actually in solution in the meteoric water circulating through our rocks and drifts. I am not aware of direct experiments having been made to solve this question, but that gold will most probably be found, is indicated by an analysis made by Mr. Daintree. I quote his own words :— "In testing a solid mass of iron pyrites gold was found throughout. This mass retained the structure of a tree stem, and was a replacement of the organic structure by pyrites, and had been taken from the Ballarat drift. The same experiment on another tree stem, taken from the same drift, has been repeated by Mr. Newbery, the Geological Survey Analyst, with a like result.

I referred to the mammillary form the gold assumes in No. 2 specimen, which appears to be analagous to that presented by the surface of nuggets. Analogy, however, though generally a truthful guide, if relied upon too implicitly in outward semblances, may lead to erroneous conclusions. Nevertheless the striking similarity in the surface of the artificial production to that of the natural gold is a point worth noticing. For if the form of the latter is the result of abrasion of its surface by the material carried along by the streams that once swept down the courses of our old "leads," then our analogy will not hold good. Yet when we have no evidence of the existence of such large nuggets in the reefs, and this theory introduces a means of producing results like those in nature, we are justified, in the absence of such evidence, to attribute these results to analogous causes. Otherwise to what origin shall we ascribe the presence of gold in pyrites that has been formed in wood imbedded in the auriferous drifts, and the fact that sometimes gold encloses a nucleus of brown iron ore, &c., unless it was deposited from solution?

That gold may be greatly purified by dissolving and reprecipitating it is strong evidence in favour of the theory attributing to a similar cause the greater purity or higher standard generally of alluvial than reef gold.

It would be premature for me to speculate further on the hypothesis of the growth of gold—the formation of nuggets in the drift, on which the above recorded few simple experiments may perhaps throw some light—until the result of more comprehensive and systematic experiments which are

now being conducted by Mr. Newbery are known. In conclusion, I beg to acknowledge my indebtedness for some points in the foregoing to a Report on the Minerals of Victoria, just completed, by Mr. G. F. Ulrich, of the Geological Survey.

Art. III.—*On the Extraction of Gold.* By Mr. H. A. Thompson.

(Read 11th September, 1866.)

The paper I have the honour to lay before the Royal Society has been compiled from my notes of experiments extending over the last six or seven years, and entered upon with a view of diminishing the heavy loss of gold now sustained in reducing quartz. The greater portion of these experiments were carried out at the works of the Port Phillip Company at Clunes by the officers of the company, or in conjunction with them, and are the more important as on that large establishment there is every facility for conducting the trials upon a working scale, while an assay office attached to the works allows of every step being tested with the accuracy which alone can make the results obtained reliable. It has long been known that a greater loss occurs in the treating of gold ores than is the case with any other metal; and although this subject has attracted the notice of scientific and practical men for many years, the advance hitherto made has hardly been commensurate with the attention bestowed upon it.

In the old gold mining works of Europe and South America the loss runs from twenty-five per cent. of the total contents of the quartz upwards, notwithstanding the accumulated experience of several generations of miners; and in California Professor Silliman reports that his examination of tailings from the different works in the Grass Valley, showed a loss of eighty dollars (say four ounces) of gold per ton, and he adds, "on the authority of one of the most cautious and experienced metallurgists of California, that the saving in a large number of cases was barely thirty per cent. of the gross contents of the ore, as determined by his own careful assays both of the ore and the waste."

In this colony assays of tailings from many different goldfields have led me to the conclusion, that the average loss sustained in crushing is not less than thirty-five per cent. of